

UPPER PERMIAN COLEOPTERA AND A NEW ORDER FROM THE
BELMONT BEDS, NEW SOUTH WALES.

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(Plates xlv.-xlvi. and three Text-figures).

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Up to the present, the earliest known fossil beetle elytra have been those of the Trias. In the Upper Trias of Ipswich, the Order Coleoptera is dominant, nearly half the total number of insect fossils so far discovered there belonging to this Order.

M. D. Zalessky recently described (Mém. Com. Geol., cxxxix., New Series) an alleged fossil beetle (not an elytron) of Permian age, naming it *Microcantharis minutus*, and assigning it to the family Ptiliidae (Trichopterygidae). The total length of this peculiar impression is only 20μ , i.e., about one-twentieth that of the smallest beetles known to exist! Neither in the excellent photomicrographs (x 900) nor in the description of this specimen can I find anything which proves it to be even an insect, much less a beetle, and I do not think further notice need be taken of it.

The assemblage of Upper Permian insect wings discovered at Belmont by Mr. John Mitchell some years back consists of the most highly specialized Palaeozoic types yet discovered anywhere in the world. The Orders so far brought to light there are the Hemiptera-Homoptera, Mecoptera, Paramecoptera and Neuroptera-Planipennia. Such an assemblage is one amongst which there would be a high probability of the occurrence of Coleoptera, since these latter are morphologically more archaic in most respects than any of the Orders just mentioned, except the Homoptera. This being so, both Mr. Mitchell and his more recent co-workers, Mr. and Mrs. T. H. Pincombe, have kept a careful watch for the possible occurrence of beetle elytra during their explorations of the Belmont Beds, and both have been well rewarded. Of a total of thirty specimens discovered (excluding numerous fragments not complete enough to name), no less than six are Coleopterous elytra, and four of them are excellently preserved, so that almost every detail of structure can be made out. Four of these are small elytra which appear to be ancestral to the Upper Triassic genus *Ademosyne* and allies; another (a large elytron with only faint traces of sculpturing, but with a well preserved *abula* exactly like that of the recent genus *Hydrophilus* itself) may be considered, without any reasonable doubt, to be one of the direct ancestors of the existing Hydrophilidae.

In addition to these, it has fallen to Mr. Mitchell himself to make the finest discovery of all, viz., an almost complete elytron, of large size and beautiful preservation, which differs from all known Coleopterous elytra in being exceedingly flat, with a straight sutural margin, and in having a complete system of venation clearly marked upon it. As this fossil exists side by side with true beetle elytra, it cannot itself be one of the ancestors of the Order Coleoptera. Nevertheless it is clear that it belongs to the Order from which the Coleoptera themselves arose, just as the Protodonata belong to the Order ancestral to the true Odonata, though now known to have existed for a considerable period side by side with them. For this fossil, then, the new Order Protocoleoptera is proposed, and its position will be intermediate between the Carboniferous Protoblattoidea (with whose venation it is in rather close agreement) and the true Coleoptera.

Order **COLEOPTERA.**

PERMOPHILIDAE, fam. nov.

Elytra resembling those of recent Hydrophilidae in general form and possessing a well developed *alula* (text-fig. 1, *al*), but without the angulation of the sutural and lateral margins near base, found in recent Hydrophilidae; sutural and lateral margins both very narrow; convexity slight; sculpture slight or absent.

PERMOPHILUS, n.g. (Text-fig. 1).

Medium to large elytra, about one-third as broad as long, with pointed apex; alula well rounded, attached close to base on posterior side, as in Hydrophilidae.

Genotype, *Permophilus pincombei*, n.sp. (Upper Permian of Belmont, N.S.W.).

PERMOPHILUS PINCOMBEI, n.sp. (Text-fig. 1, *a*).

Total length of elytron, 21.5 mm., being the full length except for the extreme tip, which is missing; greatest breadth, 7 mm. Alula almost circular, diameter 1.8 mm. Sutural margin exceedingly narrow, strongly curved for about 4 mm. from base (this portion forms the scutellar margin), then running fairly straight to half-way, finally inclining inwards very slightly. Lateral margin (costa) with basal portion missing for 4 mm., thence running nearly straight and subparallel to sutural margin to half-way, thence curving markedly inwards and finally converging strongly towards sutural margin; although the actual apex is missing, it was evidently strongly pointed, as in *Hydrophilus* (Text-fig. 1, *b*).

No definite longitudinal striae are present, but here and there are to be seen very faint traces of a delicate, branching venation; in several places the area between two more or less parallel veins appears to be furnished with very weakly formed, flattened tubercles of considerable size (diameter 0.2 to 0.3 mm.), either more or less circular or slightly hexagonal. Along the internal edge of the thickened sutural margin near base, running out from the hinge of the alula, is a series of four more strongly marked tubercles of much smaller diameter; probably these are the impressions left by a row of four deeply marked punctae in the original elytron, while the weak, flattened tubercles above mentioned may have been shallow depressions between the obsolescent veins.

Type, Specimen No. 23 T. in Mr. Pincombe's Collection.

Horizon: Upper Permian of Belmont, N.S.W.

This species is dedicated to its discoverer, Mr. T. H. Pincombe of New Lambton, near Newcastle.

PERMOPHILUS (?) MINOR, n.sp.

A poorly preserved but complete elytron; total length, 10 mm., greatest breadth, 3.6 mm. Alula not preserved. Shape somewhat similar to the previous species, but the apex not quite so sharp. No signs of sculpture or venation except, here and there, slight indications of faint longitudinal striae.

Type, Unnumbered specimen in Mr. J. Mitchell's Collection.

Horizon: Upper Permian of Belmont, N.S.W.

PERMOSYNIDAE, fam. nov.

Small elytra without any definite humeral or scutellar angle; more or less strongly convex, about one-third as wide as long, or a little over, with apex moderately pointed. Sculpture consisting of nine longitudinal striae, of which the first* (counting from lateral margin or costa) is continued nearly to apex, receiving two or more of the succeeding striae upon itself distally.

PERMOSYNE, n.g. (Text-fig. 2).

Elytra about 3 mm. in length, with lateral margin not thickened, sutural margin well-formed but narrow, and both margins considerably curved. Striae either plain or punctate, the second, third and fourth striae ending on the first, the eighth ending on the ninth; ninth stria (next to sutural margin) arising basally considerably further from margin than from eighth stria; usually a vestige of a short tenth stria in basal part of interval between ninth stria and margin.

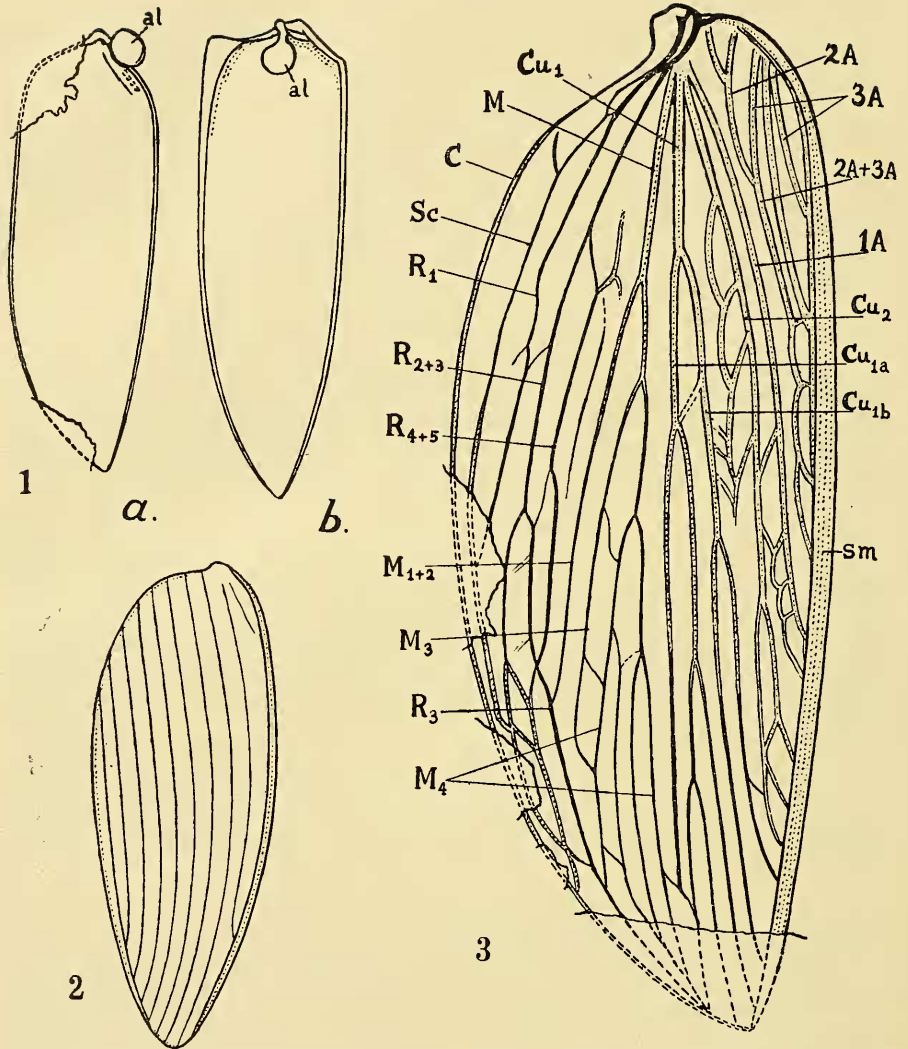
Genotype, *Permosyne belmontensis*, n.sp. (Upper Permian of Belmont).

This genus contains elytra very similar in general appearance to those of the Upper Triassic genus *Ademosyne* Handl., found at Ipswich, Q., and Narellan, N.S.W., but distinguished from them by the very typical arrangement of the striae.

Key to the Species of Permosyne.

1. Elytra with simple longitudinal striae 2
 Elytra punctate-striate 3
2. Longitudinal striae very evenly placed, none of them sinuate except the second, which is only slightly so; lateral and sutural margins distinctly curved when approaching apex *P. belmontensis*, n.sp.
 Longitudinal striae not so evenly placed, the second, third, eighth and ninth slightly sinuate; lateral and sutural margins nearly straight when approaching apex, so that the elytron is narrower and more triangular distally than in previous species *P. affinis*, n.sp.
3. Breadth distinctly greater than one-third of length; punctate striae very strongly marked *P. mitchelli*, n.sp.
 Breadth just one-third of length; punctate striae only weakly marked *P. pincombeae*, n.sp.

* Most Coleopterists appear to number the striae from the sutural margin outwards; but this is proceeding from the posterior border of the wing towards the anterior border, and appears to me to be illogical; I therefore number them from the anterior border backwards or inwards.



1. *a*, *Permophilus pincombei*, n.g. et sp., elytron (x 2.7), with missing portions restored by dotted lines; sutural margin to right, lateral margin (costa) to left; *al*, alula. *b*, *Hydrophilus latipalpus* Cast., Recent, fam. Hydrophilidae, elytron for comparison with *a*, (x 2.7).

2. *Permosyne belmontensis*, n.g. et sp., elytron (x 20); drawn from type-counterpart, sutural margin to right, lateral margin (costa) to left, and slightly broken basal portion restored.

3. *Protocoleus mitchelli*, n.g. et sp., elytron (x 6), sutural margin (*sm*) to right, lateral margin (*C*) to left, missing apical portion restored by dotted lines. Venational notation (Comstock-Needham):—1A, 2A, 3A, the three anal veins; *C*, costa; *Cu*₁, first cubitus, with branches *Cu*_{1a}, *Cu*_{1b}; *Cu*₂, second cubitus; *M*, media, with branches *M*₁₋₂, *M*₃, *M*₄; *R*₁, main stem of radius; *R*₂₋₃, *R*₄₋₅, the two principal branches of the radial sector; *Sc*, subcosta.

PERMOSYNE BELMONTENSIS, n.sp. (Plate xlv., fig. 1; text-fig. 2.)

Total length of elytron, 3.1 mm.; greatest breadth, 1.3 mm. Sutural margin narrow but strongly marked, well curved. Basal third of lateral (costal) margin apparently with a marked thickening, from the inner edge of which the first three striae appear to arise; second stria ending on first a short distance from its end, third stria ending on first almost at its end; fourth to seventh striae ending on lateral margin not far from apex, eighth almost at apex, ninth on sutural margin at one-fourth from apex. Slight indications of the beginning of a short stria at base of elytron, in the rather wide space between ninth stria and sutural margin.

Type, Specimen 13a T., and type-counterpart Specimen 13b T., in Mr. T. H. Pincombe's Collection.

Horizon: Upper Permian of Belmont, N.S.W.

PERMOSYNE AFFINIS, n.sp. (Plate xlv., fig. 2).

Total length of elytron, 2.9 mm.; greatest breadth, 1.1 mm. Differs from the previous species in its more pointed shape apically, in the more evenly rounded humeral margin, and in having the lateral margin apparently strongly thickened at its extreme base. Third and fourth striae apparently arising from a common stalk at about one-fifth from base; seventh to ninth striae more sinuate basally; space between ninth stria and sutural margin wider basally than in previous species, with indications of a short tenth stria on it; eighth stria as well as ninth ending on sutural margin.

Type, Specimen No. 92 in Mr. J. Mitchell's Collection.

Horizon: Upper Permian of Belmont, N.S.W.

PERMOSYNE MITCHELLI, n.sp. (Plate xlv., fig. 3).

Total length of elytron, 3.0 mm.; greatest breadth, 1.2 mm. The elytron is perfect except for the extreme apex and base, which are jaggedly broken off, and the sutural margin, of which only the middle third is preserved. Punctae strongly marked throughout, the distances between successive punctae being definitely less than the distances between successive striae in the middle of the elytron. Second stria very sinuate basally, arising close to third; the other striae very regularly arranged, not sinuate.

Type, Specimen No. 79 in Mr. J. Mitchell's Collection.

Horizon: Upper Permian of Belmont, N.S.W.

This species is dedicated to its discoverer, Mr. John Mitchell.

PERMOSYNE PINCOMBEAE, n.sp. (Plate xlv., fig. 4).

Total length of elytron, 3.3 mm.; greatest breadth, 1.1 mm. Differs from the previous species in being longer and narrower, much more pointed apically, and having the punctate striae more weakly marked, the distances between successive punctae being about the same as those between successive striae in the middle of the elytron. The elytron is completely preserved, but, unlike the previous three species, it is strongly carbonized, and the impression is not as clear as in the others.

Type, Specimen No. 14 T. in Mr. Pincombe's Collection.

Horizon: Upper Permian of Belmont, N.S.W.

This specimen is dedicated to Mrs. T. H. Pincombe, who has done valuable work with her husband in exploring the Belmont Beds.

PROTOCOLEOPTERA, ordo nova.

Primitive insects resembling Coleoptera but having flattened, tegminous elytra with straight sutural margin and a complete system of wing-veins developed. Costal margin greatly curved. Membrane strongly punctate between the veins.

PROTOCOLEIDAE, fam. nov. (Plate xlvi.).

Large, broad elytra having all the veins from Rs to Cu₂ strongly branched, one branch of the radius curving round subparallel to costa and junctioning with the successive branches of Rs and M in turn. Cu₂ a long vein marking off a definite anal area, ending more than half-way from base; on this area, 1A lies just below Cu₂ while 2A and 3A arise in a group by themselves from the curved basal portion of the sutural margin.

PROTOCOLEUS, n.g. (Plate xlvi., fig. 5; text-fig. 3).

Elytron broad, flat and fairly strongly chitinized, with strongly curved costal margin. Sc arising as a deep furrow vein, close to costal margin at base, then diverging slightly from it, but approaching it again distally. R₁ a strong, slightly curved vein ending distally on R₂; Rs arising close to base and branching at about one-fifth of the wing-length from base; R₂₋₃ branches again at about half-way along the wing, R₂ running into R₁ but R₃ continuing to run sub-parallel with the margin and receiving the ends of R₄₋₅ and the branches of M upon itself, finally ending up close to the apex. M developed basally as a weakly chitinized and rather broad, flat vein, with its first anterior branch at about one-fourth of wing-length; from this point onwards it becomes a strongly marked but narrow vein, with its main stem approximately along the mid-longitudinal axis of the elytron, though slightly arching between successive branches; four anterior branches are given off in succession, the first three of which end up on R₁ (extreme apex missing). Cu a broad, flattish, rather weakly chitinized vein, branching into Cu₁ and Cu₂ very close to base; each of these veins is again branched more or less dichotomically, the upper part of Cu₁ running below and subparallel to the main stem of M. 1A arises as a broad, flat vein just below Cu₂, and runs with a slight curve below it to end, without branching, at about two-thirds of the wing-length. The other two anal veins arise far from 1A on the curved basal portion of the sutural margin, 2A being simple, 3A branched; the anterior branch of 3A junctions with 2A to form a Y-vein. Sutural margin broad and nearly straight except at base, where it is stouter, narrower and much curved.

Genotype, *Protocoleus mitchelli*, n.sp. (Upper Permian of Belmont, N.S.W.).

PROTOCOLEUS MITCHELLI, n.sp. (Plate xlvi., fig. 5; text-fig. 3).

Total length of preserved portion of elytron, 21.5 mm., indicating a complete elytron of total length about 24 mm.; greatest breadth, 7 mm. The elytron is ochreous in colour on the usual pale-greyish, cherty shale of the Belmont Beds, and is impressed with the underside uppermost, so that the veins are all grooves of varying depths, with the exception of the deeply concave base of Sc, which stands up as a strong ridge; the strongly formed base of R appears as a deeply impressed groove below the raised Sc. Apart from these inequalities, the rest of the elytron is very flat. The extreme base of the elytron is of peculiar form, the attachment to the thorax having been apparently effected by means of a single large callus at the base of the subcosta and radius; this

swelling perhaps represents a fusion of originally separate anterior and posterior calli. From below this callus the posterior margin arches strongly away in a direction almost exactly opposite to that of the costa, and then curves strongly round into the sutural margin; hence the extreme basal posterior part of the tegmen lies actually at a level anterior to the origins of the veins Sc, R, M and Cu. This is in strong contrast with the condition seen in Blattoidea, where the base of the costal margin projects more or less anteriorly to the rest.

Venation as given in the generic definition. Sculpture consisting of very numerous, minute pits or punctae, scattered for the most part irregularly over the whole of the membrane between the veins, but showing a marked tendency to become arranged in lines along each side of the veins. The spaces between successive veins contain these pits from two to four deep, according to their width.

By turning the photograph in Plate xlv., fig. 5, upside down, so as to reverse the lighting, the elytron will appear with raised veins and sunken pits; this is the appearance which it would have had in life if viewed from above. In the actual impression, the pits show as tiny raised tubercles, the veins as grooves or channels.

Type, Specimen No. 81 in Mr. J. Mitchell's Collection (date on label, 1922).

Horizon: Upper Permian of Belmont, N.S.W.

This species is dedicated to its discoverer, Mr. John Mitchell, to whom also the first discovery of true Coleoptera in these beds is due.

In conclusion, I desire to express my thanks to Mr. W. C. Davies, Curator of the Cawthron Institute, for the excellent photographs from which the Plates have been made.

Explanation of Plates xlv.-xlv.

Plate xlv.

- Fig. 1. *Permosyne belmontensis* n.g. et sp. (x 18.5).
 Fig. 2. *Permosyne affinis* n.g. et sp. (x 21).
 Fig. 3. *Permosyne mitchelli* n.g. et sp. (x 21.5).
 Fig. 4. *Permosyne pincombeae* n.g. et sp. (x 17).

Plate xlv.

- Fig. 5. *Protocoleus mitchelli* n.g. et sp. (x 8).